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Proceedings of the Maritimes Region Science Advisory Process on 4X Snow Crab Assessment

28 September 2007
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

Robert O'Boyle
Meeting Chair

Bedford Institute of Oceanography
1 Challenger Drive, P.O. Box 1006
Dartmouth, Nova Scotia
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November 2007

Compte rendu de la réunion du Processus consultatif scientifique de la Région des Maritimes sur l'évaluation du crabe des neiges de 4X

Le 28 septembre 2007
Institut océanographique de Bedford
Dartmouth (Nouvelle-Écosse)

Robert O'Boyle
Président de réunion

Institut océanographique de Bedford
1 Challenger Drive, C.P. 1006
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novembre 2007

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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SUMMARY

DFO Science Maritimes received a request from regional Fisheries and Aquaculture Management (FAM) to provide harvest advice for the 2007 4X snow crab fishery. The analyses in support of this were reviewed at a 28 September 2007 meeting of the Maritimes Region Science Advisory Process (SAP), and a Science Advisory Report (SAR) was produced. These proceedings are a record of the discussions held at this meeting.

SOMMAIRE

Les responsables régionaux de la Gestion des pêches et de l'aquaculture (GPA) ont demandé aux Sciences des Maritimes de formuler un avis sur le niveau de captures à adopter dans la pêche du crabe des neiges dans 4X en 2007. Les analyses effectuées à cette fin ont été examinées lors d'une réunion tenue le 28 septembre 2007 dans le cadre du Processus consultatif scientifique (PCS) de la Région des Maritimes, réunion qui a débouché sur un Avis scientifique (AS). Le présent compte rendu relate les discussions tenues à cette réunion.

INTRODUCTION

The fishery for snow crab in Eastern Canada commenced in 1960 as incidental bycatch to groundfish fisheries near Gaspé, Quebec. Development was slow until the 1980s, at which time it grew rapidly. Three areas developed on the Scotian Shelf: Eastern Nova Scotia (North), Eastern Nova Scotia (South), and Southwest Nova Scotia (4X), with the latter being the smallest in size. The directed fishery in 4X started in 1994 with four exploratory licences, which were made permanent in 2000. Since then, an additional five licences have been added.

DFO Maritimes Fisheries and Aquaculture Management requested Science to provide harvest advice for the 2007 4X fishery. An assessment meeting was held in the Hayes Boardroom at Bedford Institute of Oceanography (BIO) on 28 September 2007, and is documented in these proceedings. The meeting commenced with the Chair, Robert O'Boyle, welcoming the participants. He introduced Dr. Robert Miller as the invited scientific reviewer for the meeting. The rest of the meeting participants introduced themselves. The Terms of Reference, including the objectives of the meeting, was presented (Appendix 1). The Agenda and List of Participants are provided in Appendices 2 and 3, respectively. It was agreed that the outputs of the meeting would be a Science Advisory Report (SAR) and a proceedings.

ASSESSMENT

Choi, J.S. and B.M. Zisserson. 2007. An Assessment of the Snow Crab Resident on the Scotian Shelf in 2006: Focusing Upon CFA 4X. RAP Working Paper 2007/024.

Rapporteurs: R. O'Boyle and T. Worcester

Presentation Highlights

Landings in 2006 were 319 t – an increase of 6% from 308 t in 2005. The full Total Allowable Catch (TAC) of 337.6 t was not caught for business reasons. Most landings were obtained from the inshore area near Sambro. Average, non-standardized catch rates were 27.7 kg/trap, representing a marginal decrease from 28.6 kg/trap. Soft-shelled crab incidence in the commercial catch of legal sized crab is low, estimated to be 0.05%, as also were bycatch of non-target species, which represented approximately 0.324% of annual snow crab landings. However, these results were based on an observer coverage of only 3.4%.

In the near-term, recruitment is expected to increase. Pre-recruits near a 54 mm carapace width (CW) modal group (instars 9/10) have been found in large numbers. The leading edge of this modal group should begin to recruit in 2007, and full entry observed in 2010 to 2011. In the long-term, the reproductive potential of the Scotian Shelf population has increased with the substantial increase in berried female abundance in all areas. Larval production should continue for another 5 years. However, potential predators of snow crab (particularly immature and soft-shelled crab) have been found concentrated in areas with high densities of immature snow crab. This adds uncertainty to the potential strength of future recruitment to the fishable biomass. Increasing bottom temperatures on the Scotian Shelf and shrinking of potential habitat also add uncertainty and may have negative consequences on 4X snow crab.

The post-fishery fishable biomass of snow crab was estimated to be 850 t, a 13.5% decline from 990 t in 2005. Exploitation rates (by biomass) were 27% (later corrected to 34%) in 2006, relative to 20% in 2005. Projections suggest that an exploitation rate between 10 and 20% may be suitable for long-term sustainability in Crab Fishing Area (CFA) 4X. Current exploitation rates

are closer to those found in the nearly collapsed northeastern Nova Scotia (N-ENS) fishery. Numerical abundance estimates of old males (CC5) are also below the detection limit in both trawl surveys and the observed commercial catch. This may be indicative of high exploitation rates. Caution is warranted for 2007 due to low fishable biomass and low recruitment and indications of high exploitation. A reduction in TAC is recommended.

Discussion

After the presentation, R. Miller gave an overview of his comments. These were generally positive and noted that all review objectives had been met. He felt that the inclusion of information on southeastern Nova Scotia (S-ENS) and N-ENS was distracting and could be separated or reduced in prominence in the future. He generally agreed with the conclusions and summary. He noted that excellent progress had been made on the understanding of life-history characteristics of snow crab and that a good job had been done at incorporating this new information into the assessment. Specific comments on the working paper were made throughout the meeting during the review of each section.

History of the Fishery

It was noted by industry participants that the fishery was initially managed opportunistically with licence holders encouraged to 'take what they could' of the resource. At the time, the resource was felt to be spillover from the Eastern Nova Scotia (ENS) stocks and not a sustainable separate population. Since 2004, this view has changed with the need for management of a sustainable fishery on a resident population highlighted.

Life History

It was noted that the life-cycle of snow crab is very complicated, and only recently has its main features become apparent with many questions still to be answered.

It was noted that the presentation slide on life-cycle should be added to the research document.

There was disagreement that using all species of crab larval as an indication of snow crab larvae, as rock crab larvae would tend to dominate. It was noted that the Guysborough County Inshore Fishermen's Association (GCIFA) are tracking snow crab larvae.

It was asked if female crab eat smaller male crab, to which the answer was yes; which has implications for the most appropriate harvest strategy. Cannibalism is likely opportunistic and density dependent.

> *Recommendation: DFO Science create a population simulator to investigate the implications of different harvest strategies.*

It was asked whether juvenile and female snow crab had different temperature preferences than males. The answer was yes, they did have different temperature preferences. It was also asked what would happen if they were to consistently experience warmer water than they preferred. There were several options discussed, including movement, aggregation into colder water regions, increased mortality, etc. It was asked whether snow crab could be adapting to the changing temperature regime. It was suggested that this was not likely to occur at the timescale of the fishery.

Questions were also raised about the ability of snow crab to travel over large distances. It has been suggested from studies in other areas that snow crab can move 58 km per year. Movement of snow crab in 4X is not known. In general, snow crab will move a few kilometres. The main message is that 4X is getting warmer, which means that the area of preferred habitat is shrinking. There have been other times where the area of preferred habitat has dropped to low levels, including 2000.

Catch, Effort, and Catch Rates (CPUE)

There was discussion on the interaction of this fishery with that of lobster. It was noted that mature male snow crab has been used as bait in the lobster fishery, although the extent of this practice is not documented. Potential reasons for baiting with snow crab may include reduced costs and decreased scavenging by slime eels (which do not eat crab). It was suggested that this may be occurring all the way up the eastern shore, i.e., wherever snow crab are found.

> *Recommendation: Science to estimate bycatch of snow crab in the SWNS lobster fishery.*

Participants noted that the distribution of effort is influenced by the dates of the lobster season, with fishing starting after this fishery. Fishing off Sambro was felt to be due to a number of non-population related factors.

The observation of an increase in the number of small female snow crab in the lobster fishery was considered consistent with the increase in crab recruitment reported in the assessment. Also, it was noted that females prefer warmer and shallower water than male snow crab.

Due to a number of regulatory changes made in the fishery, the CPUE was not considered reflective of population abundance.

It was asked why observer coverage (source of sampling information) was different from that in ENS. Coverage in N-ENS is limited because the fishing season is so short and there are only a few places to go. Coverage in S-ENS was approximately 10%. Coverage in 4X was supposed to be 10% as well, but this was not achieved due to a shortage of observers. It is possible that the incidence of white crab and *Species-at-Risk Act* (SARA) related species is low due to the low observer coverage in 4X. On the other hand, it was felt that increasing coverage from 4 to 10% would only marginally increase the precision of the projections. It would also increase the precision of the moult composition, which contributes to an understanding of exploitation.

It was noted that observers in 4X may not have seen many white crab, but fishermen did. White crab are not covered in the soft-shelled crab protocol; however, buyers do not want to buy white crab and fishermen would prefer to avoid them.

> *Recommendation: Discuss observer coverage and development of a white crab protocol at Crab Advisory Committee meeting.*

It was noted that the observer information, including the bycatch of other species in the 4X snow crab fishery, is prorated up to the scale of the fishery using the reported catch. It was felt useful to check with prorating based on effort.

> *Recommendation: Science to compare proration of the observer information based on fishery catch and effort to confirm the robustness of the results based upon catch proration.*

Survey

It was asked whether CC5 snow crab might be missed in the survey due to its timing, i.e., perhaps the CC5 snow crab have died before the survey takes place. This was considered to be a possibility.

There was discussion on whether or not to conduct the survey after the fishery, to which the answer was that there are pros and cons to this. This led into a discussion of current Joint Project Agreement (JPA) policy in DFO.

Assessment

It was asked that when temperature goes up, do crab 'crowd' into the preferred habitat areas. To some extent, there is a concentration in these areas but not exclusively.

It was noted that the Universal Kriging by External Drift (UKED) maps crab distributions based upon habitat covariates. This implies that it is possible to map the preferred crab habitat assumed in the UKED.

> *Recommendation: DFO Science to explore how the UKED derived crab habitat area could be extracted from the kriging results.*

There was discussion on the optimal sex ratio. Anything above 1:1 female to male was considered good. It was felt though that it was more appropriate to keep the sex ratio within the range of natural variability.

Regarding fishable biomass (FB), it was noted that the expected increase projected last year did not occur. There was discussion on the relationship between FB and habitat decline. Crab are moving closer to shore to avoid offshore warm temperatures. This could be increasing the vulnerability of crab to fishing.

It was noted that high exploitation rates could be responsible for growth declines in some species (e.g., haddock). This is a young fishery and not likely an issue. There was a suggestion to develop a maximum crab size for the fishery to safeguard the gene pool of the larger, faster growing individuals.

There were questions which clarified the kriging calculations. It was noted that block kriging was used to produce the confidence intervals. It was mentioned that the FB estimate was likely optimistic by 5 to 10 % as the preferred temperature boundary was raised from 5 to 8 degrees C.

It was agreed that the low incidence of CC5 crab indicated high fishing mortality (F), but this raised the question as to what was considered high. This led to a discussion on the statement 'collapsed'. The latter typically refers to a resource in which the reproductive potential has been irreversibly harmed. It was felt better to refer to the resource as being in a critical state due to 1) low FB, 2) delayed recruitment, and 3) FB that did not increase as expected in 2007. Also, it is appropriate to use the Precautionary Approach (PA) terminology as recently articulated by DFO (DFO 2006b).

Advice

It was noted that the advice should be reformulated as per the Terms of Reference, i.e., consequences of various harvest levels, including status quo TAC (F=0.4) and F (F=0.3).

In general, the short-term future is uncertain but could be more positive in five years. A cautious approach was recommended.

Other Considerations

It was noted that the oil and gas discussion was not necessarily applicable to 4X. If information on oil and gas is to be included, it should be made more relevant to 4X.

SCIENCE ADVISORY REPORT

An overall comment was that while the ENS material was useful context, it should follow rather than precede the 4X material throughout the report. This would draw attention to the 4X material, which is the main purpose of the report.

Each section of the report was then reviewed in detail and a number of substantive comments made to reflect the discussion at the meeting. The highlights of these are presented below. It was agreed that the author would make changes to the draft SAR based on the comments made at this meeting for presentation to the Editorial Board. It was asked if participants would like to have an opportunity to comment on the SAR before it is finalized, to which the consensus was no. The SAR is required by FAM in time for its 12 October 2007 Crab Advisory Committee meeting. It was confirmed that the SAR can be produced by that date.

Context and Map

It was suggested to add the CFA boundaries to the map.

Summary

The summary bullets were not reviewed in the draft other than to ensure that their content in the body of the report. The final SAR will have bullets extracted from the body of the text.

Species Biology

A note should be made that the life history characteristics of snow crab in all CFAs are similar.

Fishery

It was agreed to delete the first paragraph.

Also, the term 'official' should be replaced by 'commercial'.

It was noted that TACs have been set higher than recommended by DFO Science. The landings and effort figures (figures 2 and 3) should be changed to line graphs.

A table should be provided that shows all relevant fisheries data, including landings, TAC, CPUE, effort, and biomass (i.e., add biomass to Table 3). This could be provided together at the end of the report.

Assessment

It was recommended that the origin of the y axis of the fishable biomass figure (Figure 7) should be zero.

The calculations on the rates of decline and exploitation rates should be checked throughout the SAR.

The discussion of the increase in sex ratio on page 13 should include mention of the increasing number of females in addition to the decreasing number of males.

It was suggested that CC4 might be a better indicator of exploitation rate than CC5. Mention of both should be included in the section on exploitation rate.

Sources of Uncertainty

It was felt that the environmental material could fit either here or in a later section on 'Other Considerations'. It was agreed that the Centre for Science Advice (CSA) Editorial Board could decide.

It was noted that the relevance of the oil and gas comments to 4X should be mentioned.

Conclusions and Advice

It was considered that the key conclusion should be that in light of the poor recruitment and low FB, as well as uncertainties due to environmental variability, a precautionary approach is warranted in CFA 4X to stop the decline in fishable biomass and promote recovery. Regarding the consequences, it was agreed to include Figure 51 of the working paper in the SAR.

CONCLUDING REMARKS

The Chair confirmed that the draft proceedings would be circulated for review and comment before being finalized. This was accepted by the participants.

The Chair then thanked all the participants and closed the meeting.

REFERENCES

DFO, 2006a. Science Expert Opinion on 4X Snow Crab Fishery for 2006/2007. DFO Science Maritimes Expert Opinion 2006/09.

DFO, 2006b. A Harvest Strategy Compliant with the Precautionary Approach. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/023.

APPENDICES

Appendix 1. Terms of Reference

Assessment of 4X Snow Crab
Maritimes Region Science Regional Advisory Process

Hayes Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

28 September 2007

TERMS OF REFERENCE

Context

The snow crab fishery in Crab Fishing Area (CFA) 4X has occurred annually from November 1st to June 1st since 2000. In support of the fishery, DFO Maritimes Fisheries and Aquaculture Management Branch has asked Science Branch for an assessment of resource status and the consequences of various harvest levels for the coming fishing season. The current meeting is a scientific review of the assessment and projections undertaken in support of the 2007/2008 fishery.

Objectives

- Assess the overall status of CFA 4X snow crab up to the end of the 2006/2007 season, using the following indicators:
  - Abundance
    - Snow crab survey biomass index of males greater than 95 cm (commercial sizes)
  - Recruitment
    - Snow crab survey R-1 relative abundance
  - Exploitation Rate
    - Incidence of CC5 crab in the survey
    - Relative exploitation rate from the survey
  - Report on
    - Soft shell crab catches in 2006/2007 fishery
    - Bycatch of non-snow crab species in 2006/2007 fishery
- Evaluate the consequences of different harvest levels during the 2007/2008 fishery on stock abundance and exploitation rate.

Outputs

CSAS Science Advisory Report
CSAS Proceedings
CSAS Research Document

Participation

DFO Science
DFO Fisheries and Aquaculture Management
Aboriginal Communities / Organizations
Nova Scotia Government
Industry

Appendix 2. Agenda

Assessment of 4X Snow Crab
Maritimes Region Science Regional Advisory Process

Hayes Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

28 September 2007

AGENDA

09:00 - 09:15	Welcome and Introduction (Chair)
09:15 - 10:00	Review of Assessment
10:00 - 10:15	Break
10:15 - 12:00	Review of Assessment (cont'd)
12:00 - 13:00	Lunch
13:00 - 15:00	Review of Science Advisory Report
15:00 - 15:15	Break
15:15 - 17:00	Review of Science Advisory Report (cont'd)

Appendix 3. List of Participants

Assessment of 4X Snow Crab
Maritimes Region Science Regional Advisory Process

Hayes Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

28 September 2007

PARTICIPANTS LIST

Name	Affiliation	Organization
Allan Smith	Industry	4X Snow Crab
Curtis Falls	Aboriginal Communities/Organizations	Kespuwick Resources Inc.
Darrin Baker	Industry	4X Snow Crab
Jae Choi	DFO Assessment	DFO Maritimes
James Randall Wolfe	Industry	4X Snow Crab
Larry Whynot	Aboriginal Communities/Organizations	Native Council of NS (NCNS)
Mike Eagles	DFO Management	DFO Maritimes / FAM
Robert Miller	Scientific Reviewer	DFO Maritimes / PED
Robert O'Boyle	Chair	DFO Maritimes / CSA
Tana Worcester	Scientific Reviewer	DFO Maritimes / CSA
Tim Martin	Aboriginal Communities/Organizations	Native Council of NS (NCNS)
Troy Wolfe	Industry	4X Snow Crab
Winifred (Junior) Risser	Industry	SWNS

Appendix 4. List of Recommendations

Assessment of 4X Snow Crab
Maritimes Region Science Regional Advisory Process

Hayes Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

28 September 2007

- DFO Science create a population simulator to investigate the implications of different harvest strategies.
- Science to estimate bycatch of snow crab in the SWNS lobster fishery.
- Discuss observer coverage and development of a white crab protocol at Crab Advisory Committee meeting.
- Science to compare proration of the observer information based on fishery catch and effort to confirm the robustness of the results based upon catch proration.
- DFO Science to explore how the UKED derived crab habitat area could be extracted from the kriging results.